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Motor/Pump Unit, Especially for Antislip Brake Systems

The present invention relates to a motor/pump unit, especially for slip-controlled motor vehicle brake systems, including the features of the preamble of patent claim 1.

Electronically controllable motor vehicle brake systems including a pressure-generating device configured as a piston pump for generating hydraulic pressure and a motor for this purpose are principally known in the art. A piston pump of the eccentric type necessitates at least two angularly arranged bores to accommodate a driving shaft and at least one pump piston. At least one pressure valve and one suction valve are necessary for the charge changing. This type of pump suffers from the basic and constructively induced shortcoming that inevitable and audible pressure pulsations develop during fluid delivery. The running noise is principally tolerated because the pump of conventional, slip-controlled brake systems is switched on only rarely in average driving operations, for example, when a brake slip limit or a traction slip limit is exceeded. However, so-called electrohydraulic brake systems (EHB) require longer pump running periods because the pump is used to charge a pressure accumulator generally serving for the hydraulic pressure increase in wheel brakes during brake applications. An extension of the pump running period may also be related thereto when the pump - without using a pressure accumulator - is used for the direct pressure increase in wheel brakes. Admittedly, measures are

known to improve the noise behavior, e.g. pumps are known including three or more pistons causing lower pulsations in total. Nevertheless, the comfort behavior is regarded as being in need of improvement.

DE 199 18 390 A1 discloses a vehicle brake device with a two-circuit internal gear pump. The internal gear pump can be inserted as a unit into an accommodating member. For this purpose, the internal gear pump comprises several disc-shaped housing parts of equal diameter that abut on each other axially in addition to pinion/internal gear assemblies. Said housing parts are aligned relative to each other and welded at their periphery before the pump is inserted into the essentially cylindrical bore in the accommodating member. The highly accurate alignment and fixation of the housing parts is complicated and costly.

DE 100 04 518 A1 discloses an internal gear pump designed as a cartridge and including an essentially bowl-shaped first housing part which accommodates a pinion shaft, an internal gear, and a second housing part. The second housing part is centered in the first housing part, which in turn is inserted into a stepped-diameter bore of the accommodating member and secured thereto. This arrangement allows testing the cartridge separately. Nevertheless, the structural effort is considered as too high.

An object of the present invention is to devise a motor/pump unit, which avoids the shortcomings of the state of the art and allows a space-saving and low-cost integration of an internal gear pump in an accommodating member.

According to the invention, this object is achieved in that the housing parts can be arranged preliminarily on each other by at least one securing element in such a fashion that the final alignment of the housing parts relative to each other takes place when the unit is inserted into the accommodating member. According to the invention, the alignment of the pump components grouped as a unit is carried out quasi automatically upon insertion into the accommodating member. This obviates the need for the working steps relating to the alignment or adjustment. A separate cartridge for the pump is omitted. Nevertheless, the internal gear pump can be fitted for testing purposes into a testing device, the design of which corresponds largely with the design of the accommodating member.

In a favorable embodiment of the invention, the at least one securing element connects the housing parts with a relative clearance to each other, and a bore is provided in the accommodating member for the final alignment of the housing parts in a radial direction. This provision will safeguard that the internal gear pump can be integrated in the accommodating member, while double fits, cumulative tolerances, or similar conditions are avoided.

Further, in an advantageous aspect of the invention, a first housing part is fixed on the accommodating member so as to be undisplaceable in an axial direction and a radial direction and, in addition, is used to lock the pump components in the accommodating member. Consequently, the first housing part additionally fulfils a locking function for at least one other pump component, what limits the structural effort.

A pin with a first end can be provided as a securing element which is press fitted into a bore of the first housing part, said pin including a second end with a stop for securing the second housing part in position. The reverse arrangement is likewise possible.

For a simple assembly in an axial direction it is favorable that the pin is arranged in parallel to a pump shaft. Furthermore, for a simple design the pin includes a cylindrical portion, which extends through a bore of the stop-sided housing part, with the bore in this housing part having a larger diameter compared to the cylindrical portion, and with the diameter being smaller compared to the stop. This permits a form-locking pre-assembly of the unit without causing tension during the insertion into the accommodating member.

Up to three pins are provided for a safe and statically defined pre-assembly, said pins being evenly distributed over the periphery, that means they are arranged at a regular angle relative to each other.

To permit a compensation of the distances of the tips of teeth, it is favorable that the internal gear is supported in a ring, said ring being arranged in an axial direction between the housing parts, and said ring being pivotable relative to the housing parts about a pivot axis that is arranged in parallel to the pump shaft.

To allow an elastic preload of the ring, a housing part accommodates an end of a spring element, while another free end of the spring element is engaged in a bore of the ring

under elastic deformation, especially subjected to bending. The result is that the spring elements cause elastic preload between internal gear and pinion.

Details of the invention as well as further features, objectives, advantages and embodiments thereof will be explained in detail hereinbelow by way of the accompanying drawings. All features described and/or illustrated per se, or in any desired suitable combination, represent the subject matter of the invention, irrespective of their combination in the claims or their appendencies. Corresponding reference numerals in the drawings designate corresponding components or features. In the drawings,

Figure 1 is an enlarged cross-sectional view of an internal gear pump from obliquely above.

Figure 2 is a cross-sectional view of an internal gear pump according to Figure 1 from obliquely below.

Figure 3 is a cross-sectional view of a motor/pump unit.

Figure 4 is an enlarged view showing details of an internal gear pump like in Figure 3.

The invention relates to a motor/pump unit 1, as shown in Figure 3, which comprises an electric motor 2 that is attached to an accommodating member 3 for hydraulically active components, such as especially electromagnetically operable valves, accumulator chambers, and channels interconnecting these components. Motor 2 comprises a bowl-shaped motor housing that is covered at the end by an end plate 4, which is

preferably made of plastic material and used for the temporary accommodation of a bearing 5. Said accommodation does not serve to carry off bearing forces during operation of the motor/pump unit 1 but only for a pre-assembly of structural components so that the motor 2 along with a provisionally supported driving shaft 6 can be tested as a separate modular unit. With the bearing 5, the driving shaft 6 is supported in a bore 7 close to the accommodating member to accommodate a pump 8. Pump 8 is configured as an internal gear pump and includes a supply channel 9 for the connection of a pressure fluid reservoir such as, in particular, a brake fluid tank, a master cylinder or a simulator with a separable displacement chamber 10, as well as a discharge channel 11 leading from the displacement chamber 10 in the direction of at least one pressure fluid consumer, such as a pressure fluid accumulator and/or wheel brakes. A pinion 13 is arranged at a pump shaft 12 in an unrotatable fashion. The connection is carried out by means of a press fit or a shrinking operation. For driving purposes, the pump shaft 12 is coupled to the driving shaft 6 in the area of freely protruding pivots 14, 15 by means of a separate shaft coupling. It is, however, possible to interconnect the two shaft ends directly by a corresponding design, that means without a separate shaft coupling. Due to a rotating entrainment, the pinion 13 meshes with an internal gear 16 that is embraced by a ring 17 (compensation ring) for the mounting support. Pinion 13 comprises a smaller number of teeth than the internal gear 16. For example, a difference of one tooth is provided. The internal gear 16 is arranged eccentrically in relation to the pinion 13. The meshing of the pinion-internal gear combination causes inlet-side tooth gaps to be filled with the medium being pumped, in particular brake fluid. On the one hand, there is a sealing effect between

abutting tooth edges and, on the other hand, a sealing effect between abutting tooth heads so that a suction area is separated from a pressure area, and displacement takes place in such a way that the medium is pressed out at the outlet side for pressure increase. A bearing 18, preferably a sliding bearing or alternatively a roller bearing, in particular a needle ring as illustrated in Figures 1 and 2, is used to support the internal gear 16 in the ring 17 in a radial direction. To reduce the surface pressure that acts on the internal gear 16, an outside periphery facing the bearing can be enlarged compared to a toothing area corresponding to Figure 4. To compensate tooth head distances, the ring 17 is pivotal within certain limits about a pivot axis A in the form of a pin 46 so that in the pump operation a portion of ring 17 that lies in a mesh-free internal gear area will move substantially in a radial direction to a pinion axis 19 due to the pressure forces (force resultant) that act on the internal gear 16 in the displacement chamber (pressure chamber) so that tooth heads on the low pressure side will seal on account of their mutual abutment. The pin 46 is arranged in bores 47, 48 of the housing parts 20, 21. Principally, at least one separate pin 38 (Figure 1 and Figure 2) is used as a securing element, being pressed with a first end 39 into a bore 40 of the housing part 21 and including a stop 42 at a second end 41 to secure the housing part 20 in position. Pin 38 extends exactly as pin 46 in parallel to the pump shaft 12. Further, pin 38 includes a cylindrical portion 43 extending through a bore 44 of the stop-side housing part 20. Bore 44 has a diameter which is larger compared to portion 43, but smaller compared to the stop 42, with the result of a form-fit securing arrangement. The use of several securing elements,

such as the use of two or three pins 38 which are provided at a regular angle α is favorable.

The pump shaft 12 extends through aligning bores of the housing pars 20, 21 lined with sliding bearing elements 22, 23. Said sliding bearing elements 22, 23 are preferably press fitted into the bores, the first sliding bearing element 22 being provided within the first housing part 20, while the second sliding bearing element 23 is arranged inside the bore of the second housing part 21. The bearing forces of the sliding bearing element 22 are introduced through the housing part 20 into the accommodating member 3 in all embodiments. To support the pump shaft 12, the housing part 20 according to Figures 3 and 4 is generally bowl-shaped and includes a generally flat bottom 24 with a through-bore 25 in which the sliding bearing element 22 is inserted, which supports an end of the pump shaft 12 directly beside the pinion 13. For the introduction of force into the accommodating member 3, a tubular collar 26 that is integrally arranged at the disc-shaped bottom 24 is provided and fixed at the accommodating member in the area of a wedged portion 31. In an axial direction, the housing part 20 abuts with a tubular connection piece 49 that embraces the pump components outwards on a step 28. The bore 7 has several steps and includes a first step 27 that passes over into a second diameter portion with the second step 28. Also, housing part 21 is supported on the second step 28 in a fluid-tight fashion by means of a sealing element 29. A third diameter portion with a third step 30 accommodates the sliding bearing element 23 so that the bearing forces are introduced into the blind-hole-type end of bore 7. The housing part 21 does not participate in the introduction of force into the accommodating member. This type

of construction permits designing the bore 7 of the accommodating member 3 with comparatively coarse tolerances, while the fine tolerances are related to the pump components. Another special feature of the embodiment according to Figure 4 involves that pin 46 is designed like pin 38 according to Figure 1 so that two functions (safety function, compensation function) are fulfilled by one single component (pin 38).

The embodiment according to Figure 1 and Figure 2 differs as follows from the embodiment according to Figure 3 and Figure 4 described hereinabove. The housing parts 20, 21 have the shape of plates and are supported in each case with an outside periphery on an inside wall of bore 7 for the introduction of the bearing forces. For this purpose, the bore 7 is manufactured in one operation by means of one single tool with a high rate of accuracy.

In contrast to known internal gear pumps, all embodiments have no separate axial discs for forming the supply channel 9 and the discharge channel 11 because this function is integrated into the housing parts 20, 21. Pinion 13 and internal gear 16 move in an axial direction to directly abut on the housing parts 20, 21.

All embodiments are identical in that the pivot axis A is also used to position the second housing part 21 in a circumferential direction relative to the first housing part 20. After the assembly of the pump in bore 7, a rotation of the housing parts 20, 21 relative to each other is prevented by means of a component, i.e. axis A (pin 38, 46). In the embodiment according to Figure 3 and Figure 4, pin 46 is even used to achieve the compensation effect without the need to

provide a bore in the accommodating member to accommodate the axis A. The respective components are positioned relative to each other already as a pre-assembled construction unit.

Further, all embodiments have in common that the first housing part 20 with respect to the accommodating member 3 is defined preferably by means of axial abutment on a step (27 in Figures 1 and 2; 28 in Figures 3 and 4). The housing part 21 is only accommodated in the stepped bore 7 and bears against step 28 in a close sliding fit (transition fit). There is no independent attachment.

Figure 4 displays an elastically biased, needle-shaped spring element 32 which is inserted with a first end 33 into a bore 34 of the first housing part 20, favorably in a press fit, and engages with a second end 35 under elastic deformation (bending) into a bore 36 of the ring 17 in order to retain it in a defined inactive position. The embodiment according to Figure 1 and Figure 2 can be equipped with a spring element of this type, even if it is not shown in the drawing.

To seal a high-pressure area in relation to a low-pressure area, a sealing element 37 is provided in a space 45 between the housing part 20 and the pump shaft 12, said sealing element being press fitted into an inside wall of the collar 26 and bearing with one or more sealing lips against the pump shaft 12.

List of Reference Numerals:

1	motor/pump unit
2	motor
3	accommodating member
4	end plate
5	bearing
6	driving shaft
7	bore
8	pump
9	supply channel
10	displacement chamber
11	discharge channel
12	pump shaft
13	pinion
14	pivot
15	pivot
16	internal gear
17	ring
18	bearing
19	pinion axis
20	housing part
21	housing part
22	sliding bearing element
23	sliding bearing element
24	bottom
25	through-bore
26	collar
27	step
28	step
29	sealing element
30	step

31	wedged portion
32	spring element
33	end
34	bore
35	end
36	bore
37	sealing element
38	pin
39	end
40	bore
41	end
42	stop
43	portion
44	bore
45	space
46	pin
47	bore
48	bore
49	connection piece
A	pivot axis